



4FCROPS

**Future Crops for
Food, Feed, Fiber and Fuel**

Minutes of the third 4FCROPS workshop

“Can the production of non-food crops be environmentally friendly and economically viable?”

Poznan, 17/11/09

**Prepared by CRES
30/11/09**



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Poznan, 17 November 2009

Third Workshop of the 4FCROPS Project:

INF & MP

Instytut Włókien Naturalnych i Roślin Zielarskich,
Wojska Polskiego 71b

“Can the production of non-food crops be environmentally friendly and economically viable?”

8:30-9:00 *Registration*

Session I **Chairman: Prof. Ralph Sims, IEA Bioenergy**

9:00	Welcome speech	<i>Dr. Grzegorz Spychaiski Director of INF&MP</i>
9:20	4F CROPS: a brief introduction to the Project	<i>Dr. Efi Alexopoulou, CRES</i>
9:30	Life cycle assessments of future crops for fiber and fuels	<i>Mr. Nils Rettenmaier, IFEU</i>
10:00	Future challenges to sustainable production from land based industry (economically, environmentally and socially viable)	<i>Prof. Melvyn Askew, CENSUS BIO</i>
10:20	Renewable resources in Poland - could they be environmentally friendly and economically viable?	<i>Dr. Maria Mackiewicz-Talarczyk, INF&MP</i>

10:40 *Coffee break*

Session II **Chairman: Melvyn Askew, CENSUS BIO**

11:00	How the choice of the logistic chain can influence on the environmental impacts of the agro-energy system	<i>Dr. Luigi Pari, CRA-ING</i>
11:20	Sustainable crop production - an overview	<i>Prof. Ralph Sims, IEA Bioenergy</i>
11:40	Energy and Agricultural production - Sustainability of Biofuels	<i>Prof. Spyros Kyristis, AUA</i>
12:00	Can the production of non-food crops be economically viable? A case of arable land reallocation in Greece	<i>Prof. Peter Soldatos, AUA</i>

12:30 ***Working lunch break***

13:30-16:00 **Round table discussion and conclusions**

Chairman: Prof. Melvyn Askew, CENSUS - BIO

1. Can the production of non-food crops be sustainable?
2. The balance between energy and food crops in EU agriculture is under discussion. Can market forces regulate the shares or is there an urgent need for state intervention?
3. How to manage targets in each country?
4. How to measure biodiversity?
5. Should we focus on biorefinery?
6. How to prioritise the uses of hemp? Is it the production of fibrous materials, the energy production or the impact on rural economy?

16:00-17:00 **Visit of the Institute Natural Fibres and Medicinal Plants**

Introduction

Dr. Grzegorz Szychaiski, Director of the INF & MP

Dr. Grzegorz Szychaiski, Director of INF & MP welcomed the invited speakers, the coordinators of the projects 4FCROPS and Crops2Industry as well as the invited speakers and workshop participants.

He shortly presented the mission of the Institute of Natural Fibres and Medicine Plants (INF & MP) and added his personal opinion related the theme of this workshop. He advised that we have to adjust the demands to our limited resources, limited in terms of economy but also in terms of availability.

Three pillars of sustainable development should be taken under consideration:

- ♦ **Economy**, all participants of the trade chain wait for the adequate benefits
- ♦ **Ecology**, natural environmental is the fundamental value for economic system and should be treated as the base for any activity,
- ♦ **Society**, people should feel satisfaction and welfare while they work, earn money and use the natural environment.

There are **four main challenges** for the food and non-food activity based on the land:

- ♦ **Starvation**, shame of civilization
- ♦ **Globalization**, internalization of production and trade and consumption
- ♦ **Demography**, in 2025 the population of the world is predicted to be 8.0 billions people and the produced food has to cover their demands.
- ♦ **Economy**, incomes of rural societies and food and non-food consumers in China, India and East Europe.

The answers to the above challenges could be found to EU policy and to new world deal.

Introduction from the workshop chairmen

Prof. Melvyn Askew and Prof. Ralph Sims

Prof. Melvyn Askew and *Prof. Ralph Sims* (chairmen of the workshop) welcomed the audience of the workshop. *Prof. Ralph Sims* is going to chair the first session and *Prof. Melvyn Askew* the second.

Prof. Melvyn Askew pointed out that the most important part of this workshop is the **round table discussion** and the participation of all participants will have an added value to the outcome of the today work.

Dr. Efi Alexopoulou, CRES

Presentation of the project 4FCROPS

Dr. Efi Alexopoulou welcomed the invited speakers and participants and thanked *Dr. Grzegorz Szychaiski*, Director of INF&MP and *Dr. Maria*

Mackiewicz-Talarczyk for their valuable help in organising this workshop as well as the workshop of the Crops2industry project.

Dr. Alexopoulou presented in brief the project 4FCROPS (www.4fcrops.eu) that was the reason for the organisation of this thematic workshop.

4FCROPS started in June 2008 and will finish in May 2010. The project is a dissemination and support action one and its main aim is to survey and analyse all the parameters that will play an important role in a successful non-food cropping systems alongside the existing food crops systems.

The project will accomplished its aims through eight work packages: 1) land use in EU27, 2) cropping possibilities, 3) cost analysis of non-food crops and socio economics impacts, 4) environmental analysis, 5) regulatory framework, 6) best practices scenarios, 7) dissemination and support actions and 8) management and coordination.

Key element to the success of the 4FCROPS is the thematic workshops that have been scheduled. Up to now two thematic workshops had been organised; the first in Bologna (September 2008) with theme “**Market needs of non-food crops in EU27**” and the second in Madrid (24/3/09) with theme “**Which are the key future non-food crops in EU27?**” and today is the third one.

Another important element to the project success is the scientific committee of the project that consisted from the work packages leaders and invited stakeholders that have an advisory role in the scientific committee and participate in the thematic workshops.

4FCROPS had been invited to participate in the twinning opportunity between EU and Canada that started last year with a workshop (February 2008 in Montréal) and continued this year in Pisa in the second workshop (June 2009).

Recently, 4FCROPS have been invited to participate in the twinning opportunity with Argentina and MERCOSUR project. The first meeting of this twinning opportunity took place in Buenos Aires (7&8/5/09) and the second will be take place in Athens in June or July 2010 and will be organised by CRES.

At the end of her presentation, Dr. Alexopoulou asked from the workshop participants to express their opinions during the round table discussion that is the most important part of this event.

Mr. Nils Rettenmaier, IFEU

Life cycle assessments of future crops for fiber and fuels

Mr. Nils Rettenmair started his presentation with the environmental advantages and disadvantages of the biofuels and biobased materials. The main advantages are: CO₂ neutral, save of energetic resources, reduction of the organic waste and less transport, while the main disadvantages are: land use, eutrophication of surface water, water pollution by pesticides and energy intensive production. IFEU is the 4FCROPS partner working on the

LCA analysis of the non-food crops. LCA is a tool to compare the environmental performance of two products, e.g. fossil fuel and a biofuel. All the inputs and outputs are taken under consideration. The draft version of LCA was delivered and by the end of the year the final version will be ready.

He presented how the selection of the non-food crops was done in Madrid and he presented the map with the climatic zones. IFEU then had to select representative conversion pathways (crop category, conversion path, main product and use).

He selected to present the results for the LCA analysis for sugar beets (either for bioethanol and biomaterial), sweet sorghum (bioethanol, biomaterials), rapeseed, flax and miscanthus. In all cases the advantages and disadvantages were balanced (energy savings, greenhouse effects, acidification, eutrophication, summer smog, ozone depletion and human toxicity).

The main conclusions of this LCA analysis summarized below:

- ◆ All assessed biofuels and biomaterials show environmental advantages as well as disadvantages when compared to their fossil/conventional equivalents.
- ◆ Most biofuels and biomaterials show advantages with regard to energy savings, greenhouse effect and summer smog.
- ◆ In contrast, most biofuels and biomaterials show disadvantages with regard to acidification, eutrophication and ozone depletion.
- ◆ The results don't show clear tendencies with regard to human toxicity.
- ◆ An objective decision for or against a particular fuel or biomaterial cannot be made. However, based on a subjective value system a decision is possible.
- ◆ If, for example, energy savings and greenhouse effect is given the highest priority, all biofuels and biomaterial applications assessed are to be preferred over their fossil equivalents.
- ◆ The amount of energy and greenhouse gases that can be saved greatly differs depending on the crops, conversion paths and main products.

He pointed out that the type of the produced product has a strong influence on the LCA analysis. As land-use competitions are increasing, it is necessary to allocate the limited amount of biomass to the different sectors (food, feed, fibre, fuel) in such a way which achieves the highest environmental benefits.

Prof. Melvyn Askew, Census-BIO

Future challenges to sustainable production from land based industry (economically, environmentally and socially viable)

Prof. Melvyn Askew started his presentation by setting the question what sustainability means. Sustainability is a function of economic viability, cost of environmental impact and social/cultural acceptability. Sustainability needs to be taken at a continental or even worldwide level in long term.

The major impacts of policy making are: CAP revision for 2013, land and water directives, the pesticides reductions that European parliament looking for. The consequents to use food crops for biofuels production (like corn in USA that highly subsidized) should be carefully examined.

It should also be considered that: a) the land use for environmental purposes may reduce crop areas for food production, b) the responses to global warming and to water management may mean land coming out of arable crop use and going into grassland or forestry to preserve soils and avoid erosion (this means less area for food production), c) an emphasis on bio/organic farming - cannot provide the world with current levels of food.

Prof. Melvyn Askew emphasised that we are living in a changing world. Facts that have to be considered are the global warming; the decline of the biodiversity of the ecological systems, the decline of the available area for food and feed and at the same time the population will be increase.

EU has set targets for sustainable, secure and affordable supplies of energy. The set targets by 2020 are: 20% reduction in primary energy consumption, 20% reduction in greenhouse gases (Based upon 1990), 20% renewable energy in overall energy mix (10% min biofuels). Moreover, EC set EC-Sustainability criteria.

Regarding biodiversity **Prof Melvyn Askew** pointed out that: a) the decline in biodiversity has cost over £50 billion sterling so far, b) 85% of rainforest could be killed off in the next 100 years if temperatures rise by 4 C degrees and c) 25 to 40% of African species become extinct if temperatures rise 3 C degrees.

Some impacts of the global warming are: a) major droughts or storms, in general deficit in water supply, erratic rainfall patterns, b) Great Barrier Reef disappears - no tourism, c) 3 to 5000 extra heat-related deaths per year in Australia (but NB France in 2008/9), mass migration from S. Europe & impact on land availability in N Europe, d) declining food supply and therefore food choice. There are more problems related to the global warning such as: a) new diseases of animals, b) new & increased disease & pest spectrum for crops- but pesticides declining in EU, c) need for new approaches to plant breeding to obviate the climate change impact, d) need for reappraisal of most production techniques for plants and animals esp H₂O.

Whilst global warming and water availability in particular will be key drivers affecting sustainability it must not be forgotten that policy makers are not necessarily fully linked into the system and do not necessarily understand fully the needs of land-based industry. Steps are needed to inform policy making and indeed the general public about challenges and opportunities.

Prof Melvyn Askew at the end of his presentation said that in projects like 4FCROPS, R&D has highlighted many opportunities for sustainable land - based industry. The findings now have to be introduced to political strategy and to the general public. At the same time more technology transfer at the practical level is needed.

Maria Mackiewicz-Talarczyk, INF&MP

Renewable resources in Poland-could they be environmentally friendly and economically viable?

Dr. Mackiewicz-Talarczyk started her presentation with the description of the situation for energy crops in Poland. The profitability of the cultivation of non-food crops in Poland depends on the site of the cultivation, on the selective cultivated crops and the utilization.

Rapeseed is considered the major non-food crop and its area of cultivation estimated to be 1.0 - 1.5 million ha; 50% of the harvested seeds used for human consumption, while the other 50% is being used for biodiesel production.

In Poland bioethanol can be produced by cereals, corn, potatoes, beetroot, etc. It is estimated that the total cultivation area of crops dedicated for bioethanol production will be 600,000 ha in 2020.

The selected crops for biomass production for light soils and low rainfall rate are: corn, sweet sorghum and hemp, while for heavier soils and higher rainfall rate are: willow, miscanthus and sida. Sweet sorghum gave dry matter yields 28 to 36 t/ha, corn 19 to 36 t/ha, industrial hemp 14 to 31 t/ha, willow 7 to 11t/ha, miscanthus 9-15 t/ha and sida 7-11t/ha. The energetic value of the above mentioned biomass species did not varied significantly. The insertion of hemp in agricultural practice in Poland will depend on the reform of the regulation on counter drag abuse, which will enable the use of fibrous hemp for the energy production.

The supply of the feedstock for agricultural biogas plants will depend on the involvement of agricultural advisors aiming at organization of producers groups and the service stations, equipped in the specialized machines, on providing the sale system and profitable prices for these producers those who purchase biomass (based on bilateral commercial agreements). Moreover, significant role will play the active involvement of local authority organizations, which should contribute to gaining the waste feedstock's for biogas plants, where the plant biomass should be the supplement only.

Finally, it is necessary to underline, that the success in gaining the renewable energy in the plant biogas plants depends on the level of profitability in the entire chain; from industry through the realization of the investment and exploitation program - up to the sale of the final product.

Dr. Luigi Pari, CRA-ING

How the choice of the logistic chain can influence on the environmental impacts of the agro-energy system

Dr. Luigi Pari with his presentation aimed to present the cultivation of poplar in Italy (SRF) for energy production as a case study to show how the choice of the logistic chain can influence the environmental impacts of the agro-energy system.

Electricity generation using biomass as a fuel has recently received a great interest in Italy due to favourable government funding system. The fixed tariff of 0.3 €/kWh for electricity produced in small power plants (< 1 MWe) utilising biomass produced within an area of 70 km radius from the plant, has particularly encouraged electricity production at farm level. Farmers and farmer association are investing in this opportunity and poplar grown as Short Rotation Coppice (SRC) is the main crop utilised for this purpose.

A research programme to evaluate the performance of different storage systems for various particle sizes of poplar was carried out in Savigliano, Italy. The aim was to study the effect of particle size, pile covering, ventilation and compaction of chip piles on fuel quality parameters during outdoor storage.

They managed to construct a prototype to cover these problems, but this prototype is not to be sold. Because CRA-ING is a public institute, they develop innovative technologies for planting and harvesting prototype equipment. Calls of interest are then launched and manufacturers are called in order to construct and develop proper machinery that will be released in the market.

The first machinery was developed to harvest willow and it was found that can be used also for the poplar harvesting. The willow has very thick stems, while poplar has larger stems and thus modifications had to be done. Another problem was the storage of the material. CRA-INF developed a new chopper in order to increase the size of the chips because the small size chips are a problem in storage trials.

A more environmental logistic chain was developed (from March to June the harvesting taking place). The prototype machinery just cut and the stems left in the soil. The chips were produced quite later. In the second stage machinery (light one) pick up the dry stems and chip them. At the harvest the moisture content is 50% and for storage the needed moisture content is 30%.

The main results of this study summarized below:

- ◆ The light, felling-windrowing machine was able to work during this rainy winter, postponing the use of the chopper and loader machine as well as trailers until April or May.
- ◆ The machine, still in experimental phase, harvested 50 ha and showed good performance with a 1.20 ha/h working capacity.
- ◆ This prototype is the first step for the development of the 2 rows felling-windrowing harvesters
- ◆ Windrows were harvested and chipped by Spapperi, Jordan and Claas Jaguar equipped with pick up between March and May,
- ◆ The moisture content during windrowing storage and the quality of the chip with different degrees of moisture are now under evaluation.
- ◆ The new harvesting chain permit a low soil compaction, especially on clay soil and in rainy winters, less storage problem and to enlarge the harvesting period, in other words TO DECREASE THE ENVIRONMENTAL IMPACT OF THE AGRO-ENERGY SYSTEM.

Ralph Sims, IEA Bioenergy, Massey University New Zealand
Sustainable crop production - an overview

Prof. Ralph Sims started his presentation with the topics that is going to cover, which are: to look at the broad issues of energy (IEA) and climate (IPCC); to consider the potential for future world biomass crop production; to identify the *SINS* of biomass that are barriers to its greater uptake and to outline the opportunities for biomass to become a *SAVIOUR*.

The current policies will lead to growth of 45% in energy demand by 2030 and a fossil fuel future that is unsustainable. In the annual global GHG emissions, energy contributes 65% to GHG, agriculture 10% and the land use change 15%.

There are two scenarios for the GHG emissions in 2100; 450 ppm or 550 ppm. All the efforts should focus on the first scenario (450 ppm). Even if the GHG emissions managed to be stabilised at 450 ppm there is only a 50% chance of keeping global temperature rise below 2⁰ C. For 450 ppm CO₂-eq *additional* deployment of existing *and new* low-carbon technologies accounts for most savings at US\$ 180 /t CO₂. In order the target of 450 ppm to be achieved, RES is a significant component though biofuels have a lower contribution. Biomass, and especially its traditional forms, has to have a high contribution.

The assessment of biomass supply potential in 2050 (IEA Bioenergy, IPCC) varied largely from 120 to 1200 EJ (non-food crops, forest and agricultural residues, organic wastes, animal manures) and this proves how difficult is to predict.

The main points of the Biomass Resource Scenario in 2050 are:

- ◆ In the < 2⁰ C Scenario, biomass for energy will increase three times to around 3600 Mtoe / year (150 EJ/yr).
- ◆ This will require 15000 Mt biomass / year (around half from crop and forest residues and the rest from purpose-grown energy crops).
- ◆ A further 9000 Mt /yr is needed for bio-chemicals, heating and cooking.
- ◆ Plus 3000 Mt /yr used for transport fuels and
- ◆ 3000 Mt /yr to produce 2450 TWh of electricity.
- ◆ Biomass for fibres and materials is additional.
- ◆ By 2050 most light cars will run on electricity or hydrogen so 2nd generation biofuels will be used by aviation.
- ◆ As regards LCA, lignocellulosics are positive in GHG abatement

The future non-food biomass resource can be used for transport biofuels, heat, power and combined heat and power. It can be used also for non-energy and non-food use such as bio-materials and fibres, bio-chemicals in the *Bio-Economy*, soil conditioning / nutrient cycling and bio-refineries and multi-products.

The main opportunities of Biomass to become saviour are: the increased security of energy supply (US), greenhouse gas mitigation potential (EU), supports sustainable development (DCs), used for treatment of organic wastes, provides employment opportunities, it is a relatively cheap store of energy, it is a trade able energy carrier and product, can produce multi- and

co-products, and can be used to physically reduce atmospheric CO₂ concentrations.

The future transition to a “*Bio-economy*” will be accomplished with the involvement of the national and state governments, the partnerships between the private/public sectors, the Energy industry, the Agricultural industry, the Bio-technology industry, the local governments, etc.

The main conclusions of this presentation are listed below:

- ◆ Climate change is real and adaptation is inevitable.
- ◆ How agricultural production will be affected is uncertain but more droughts, floods etc. are likely.
- ◆ The *sins* of biomass crops grown for materials, fibres, energy and chemicals can mostly be forgiven - by careful management of the land and water and by improving the various conversion processes.
- ◆ Closer liaison is needed between those producing feedstocks and those processing them. It should be pointed out that “we are running out of time.

The question is if RD&D investment and education can keep up?

Spyros Kyristis, AUA

Energy and Agricultural production - Sustainability of Biofuels

Prof. Spyros Kyristsis with his presentation aimed to discuss the energy and agricultural production as well as the sustainability of the biofuels. Regarding the energy and agricultural production four important facts should be taken under consideration:

- ◆ Poor developing countries they don't have access to energy (fuels, fertilizers) in order to develop their agricultural production, even though for them a minimum energy input could assure multiple energy output (more food etc)
- ◆ Countries spending more energy offer to their population better jobs opportunities and thus their population can spend more money for better living conditions
- ◆ In cultivated biomass, with a very positive efficiency (>3/1), the farmer can produce energy not only to cover the energy inputs for more food production per cultivated area, but also to cover the energy needed for a certain development, of course under certain limits, depending on the cultivated area/inh and local conditions.
- ◆ Recent food crisis gave floor for long discussion and problematic around the world, on the Opportunities and Threats from Bioenergy expansion.

Prof. **Spyros Kyristsis** continued his presentation by pointed out that even though the recent energy production from agriculture had a very small influence on recent food crises there are many question about the sustainability rules that bioenergy follows so far and many questions about the future threats from bioenergy.

Then he presented the case of using corn for bioethanol production. The USA accounts for about 40 per cent of global production. In 2007 about a quarter of the US corn harvest went to ethanol. This means that the US

ethanol program consumed about 12 per cent of global corn production, and displaced about 6 per cent of US transport fuel (USDA, Feb. 2008). He pointed out that U.S. corn production is a heavy user of nitrogen-based fertilizers, the true emissions of which we may only now be starting to understand, and the run-off (via Mississippi) from which is creating a “dead-zone” of 20,000 Km² in the Gulf of Mexico, (2008, National Journal of Science).

The biggest advantage of biomass use for energy is its social character, that means energy raw material has to be produced locally, covering in cost the ~60% of the final cost of the energy produced from that raw material. Access to land is a fundamental precondition in realizing the potential role of agriculture in reducing poverty. Unfortunately, one of the side effects of biofuel targets- is a “scramble to supply”, in which companies or rich and powerful investors rush to buy up new land, potentially displacing vulnerable communities whose rights to the land are poorly protected.

According to *Jacques Diout* (FAO General Director) “Biofuels present both opportunities and risks and the challenge is to reduce or manage these risks, while sharing the opportunities more widely”.

Prof. Kyrsitsis finalized his presentation with the following conclusions:

- ◆ The use of all the organic wastes and plant residues as feedstock (energy, chemicals, fiber, building material, compost), and plus an annual increase of crop productivity (~2%), are needed to secure food, feed and biofuel production.
- ◆ Besides the appropriate international food security policy, measures have to be addressed on a regional scale, because of the uneven distribution of natural resources; especially land and water.
- ◆ It is positive and to the right direction, the measures taken by E.U. in its last directive 11-12 December 2008, on R. Energies (The year 2020, Energy from RES in all E. Countries should be 20%). In these 20% RES target, Biomass is expected to contribute by 12,5% (EREC 2008)
- ◆ E. Union regulation, supports also the use of feedstock **not designated for food** and respecting the **new sustainability criteria**, saving initially at least 35% of CO₂, and up to 2017 more than 50%, with the existing installations (<1/4/2013), and more than 60%, for the new installations.
- ◆ Bioenergy feedstock should not produce: 1) in land of high biodiversity, 2) from natural forests 3) from places of high C concentration (Savannas, Peat etc.)
- ◆ In any case, the cost of biofuels will continue to be tightly related, first with the prices of fossil fuels and secondly with the food, feed, and fiber prices.

Prof. Peter Soldatos, Agricultural University of Athens

***Can the production of non-food crops be economically viable?
A case of arable land reallocation in Greece***

Prof. Peter Soldatos said that the aim of this study was to examine farmer’s options with regard to best use land and to check economic conditions and comment on financial efficiency and farm income.

After the latest CAP reform farmers are free to choose what to grow based on economic considerations. As high subsidies have been removed from several conventional crops, energy crops look now more efficient in financial terms.

Prof. Peter Soldatos presented the effect of CAP reform on arable land allocation. The reduction on the cultivation of arable land was 10% (between 1999 and 2003 CAP). The arable land in 2000-2 was 2726 million ha and 2548 million ha in 2007.

Under the new CAP, choices regarding arable land allocation must be based on economic logic. Farmers are still surviving thanks to the temporal decoupled subsidy that they receive. However, they know that sooner or later they will have to take more permanent decisions.

Then the presentation was concentrated on the case of arable land reallocation in Greece. Cotton has been cultivated in Greece for many years. Lately, together with tobacco had become the most generously subsidised crops in Europe. Until 2005, the cotton subsidy was twice the international selling price. After the implementation of the reformed CAP-2003, the coupled subsidy is just sufficient to leave a small profit to the most effective cotton producers. As a result, in the following years, cotton areas will be resulted to almost half. Greek farmers, anticipating further reductions in the subsidies received, are seeking more stable solutions for their farms.

Although cultivated in relatively small area, tobacco was traditionally one of the most outstanding crops of Greece. Its significance for the social and economic life of some of the poorer regions of Greece was high. Tobacco production in Greece has fallen by 80 percent since 2006 and the number of growers has shrunk from around 50,000 to 15,000 tonnes. In Northern and Central Greece there is increasing interest in new cropping opportunities after the release of forty thousand tobacco cultivated hectares.

Prof. Peter Soldatos presented an economic analysis for cotton, maize, wheat, barley, miscanthus (irrigated), sweet sorghum (irrigated), cardoon (irrigated and non-irrigated), rapeseed (non-irrigated) and sunflower (non-irrigated). For the economic analysis and for the non-food crops used the break-even price (break-even price is the selling price of the crop at which it gives the same profit per hectare as the competing alternative plantation). The aim of this was to compare the arable crops situation as it appears in the eyes of the farmer. In 2030 we expect another reform so subsidies may be even less.

In Durum wheat the prices fluctuated a lot. Two years ago the price was too high then was declined and now starting to increase again.

The sensitivity analysis shown that range of figures is too wide. The yields varied a lot depending upon location and cultivation treatments. The production cost may also vary significantly due to size and location, more or less irrigation, etc. Therefore, when treating individual cases, one must be more specific in order to avoid uncertain generalisations.

Round Table Discussion

Questions set by Prof. ASKEW (chairman of the round table discussion)

1. Can the production of non-food crops be sustainable?

<i>Prof. Spyros Kyritsis</i>	Speaking on sustainability, it is under consideration now days for the biofuels, with many pronounced negative opinions and statements. If third countries follow the EU directions on emission reduction and sustainability, things will change and imports would be facilitated, since they will also fulfil the European sustainability criteria. It's the first time that EU taking sustainability measures. Reallocating funds from destroying the Amazon to help the market and farmers would be a good incentive towards the development of bio energy.
<i>Prof. Ralph Sims</i>	We have to have equity of sustainability criteria in developing and developed countries. He said that climate change is very complicated in two weeks that climate change conference will take place no many answers can be answered.
<i>Mr. Nils Rettenmair</i>	It is important to follow the EU rules but lots of food and feed is imported without caring if it is sustainable. For instance, only the 5% of palm oil is used for bio energy, while the rest is used for nutrition and technical purposes. However, there are no sustainability criteria for these nutrition uses. Consequently, we have to have a global picture. Agriculture is not at all sustainable as it depends largely on fossil energy input. It very important to look to the whole LCA in order to answer and not only to focus on the farmer's profit.
<i>Prof. Ralph Sims</i>	In Europe the agriculture for sure is not sustainable. We have to have farmers on board. Another thing that we should do is change our energy consumption behaviour. We can optimise agriculture up to a certain point to assure high income for farmers and to cover the food and feed needs, but we also have to save energy.
<i>Prof. Peter Soldatos</i>	The sustainability is a global issue and government should take measures. Some regulations were established by there are only temporarily. Regulations should be required.
2. The balance between energy and food crops in EU agriculture is under discussion. Can market forces regulate the shares or is there an urgent need for state intervention?	
<i>Prof. Peter Soldatos</i>	In the recent CAP, decoupling of agricultural subsidies has made the new (energy) crops competitive in financial terms. Indirect subsidisation of agriculture is important for financial survival and maintenance of farmers in rural

	areas (social, environment, employment).
Prof. Ralph Sims	<p>It is possible to have energy without relying to agricultural subsidies. For instance, in NZ 10 years ago all subsidies were withdrawn. Some farmers faced problems at the beginning, but most of them managed to survive, formed larger-scale farms and became thus efficient and robust with high exporting opportunities.</p> <p>Within a small community such as NZ (4 millions people and 10 millions cows) , farmers are pretty well educated through dissemination activities, are environmentally sensible and have priorities so as to preserve their clear and green image, and though NZ is a small country it contributes to IPCC and other panels worldwide.</p> <p>Either you subsidy the production or you increase the final price of the product. In the latter case, we may complain on the high prices of materials, but we learn not to waste food. 30% of the food is wasted in UK. In NZ there are no more small farms but centralised in order to be competitive without subsidies.</p> <p>In New Zealand one of the priorities of research is be more environmental sustainable because the cows still pollute.</p>
Prof. Melvyn Askew	Technology transfer from science to market has to be addressed.
Dr. Valerio Zuccini	<p>Advertisements of green products are crucial for the promotion of crops as well as bio-products. People may become willing to pay more if the product they purchase is 'green'.</p> <p>Every product has to have the result of the LCA analysis and the public to be able to see if this product is green or not. In this way the public can decide what he wants to decide</p>
3. How to manage targets in each country?	
Dr. Luigi Pari	<p>In Italy in the last 20 years lots of things had happened The research started with the selection of several energy crops, then they had to cultivate on real fields and after 20 years a lot of knowledge have been collected. Thus now the research is there and there is a need for connection between research and market - industry. The researchers have to inform the policy makers where to focus, and then technical and scientific support should be given to the market.</p> <p>With the revision of CAP now business took over the ruling instead of research. Now research is directed towards:</p> <ul style="list-style-type: none"> - advising policy makers on the directions to follow - developing and providing technological solutions to the farmers

	In Italy, in terms of biomass plant capacities, at the beginning there was a push to support 50 MW installed capacity, but it was proven that local resources were limited so now they narrowed the support to lower plant capacities (1MW plants), which entails less efficiency but better use of local biomass resources).
Prof. Ralph Sims	New Zealand agriculture is a perfect example if compared to EU agriculture that heavily relies on subsidies. The level of decision in agriculture should change from local to international. In Europe there are many family farms. In Europe the people they use to buy food and to consume the half and the other half to go to the wastes.
Dr. Valerio Zuccini	Policy has to help farmers and farmers have to receive this help. To grow a crop just to grow it has no sense. High value crops have to be selected and sufficient technologies have to be applied. This change has to be gradual and market driven. High level decision makers have to be informed at first, and simultaneously on a second level, they have to inform industry and farmers to implement relevant rules and measures. In addition, LCA indicators on all products should be there, and that is also the approach of the market. It is not easy to use world trade regulations. Sustainability on equal terms all over the world as well as standardisation is of utmost importance.
Dr. Ana Luisa Fernando	In Portugal, farmers tend to cooperate and expand in size, but this is not related to policies. It was due to change of people's behaviour; nowadays there are workers from Poland or Romania working in the farms.
Mr. Nils Rettenmaier	In Germany, there are RES regulations that have changed considerably; now wastes to biogas are subsidised (together with energy maize). So the question is should we go for biofuels or no. There are competing goals in terms of bioenergy, e.g. energy security, GHG emission mitigation and job creation. Maybe these goals can't all be achieved at the same time. There are opportunities to integrate policies (region by region, country by country)
Dr. Grzegorz Sychaiski	First we should see the agricultural on international base (social-economy and political decisions are needed).
Prof Melvyn Askew	Policy makers have only 10 sec of concentration on all these issues. The transfer of knowledge from the scientists to farmers and to the policy makers is very important.
Prof. Spyros Kyritsis	There leaving from Europe and there moving to ASIA (to increase their capital income). First of all there are some common regulations for all EU-countries and then the countries have to develop their

regulations.

4. How to measure biodiversity?

Dr. Nils Rettenmaier

Removal of subsidies and market liberalisation may be threats to agro-biodiversity as only a limited number of crops are expected to be cultivated profitably in Europe. In this case, energy crops could also lead to higher agro-biodiversity by widening the crop rotations. The on-going standardisation towards a “product carbon footprint” limits the focus on GHG only, while there are more environmental impacts. Biodiversity is a complicated concept (genetic, species, landscape) thus too difficult to include it in LCA, which tends to generalise things, whereas EIA (Environmental Impact Assessment) focuses more on site specific conditions.

5. Should we focus on biorefinery?

Dr. Ralph Sims

Certainly yes! Niche markets may have high value products however the volumes are not that high. In Brazil in the 70s they used to produce bioethanol, but now because of the high price of sugar people find it expensive to buy. Therefore they export bioethanol to USA. If we want to have agricultural profitability, we could apply the bio refinery concept, so that remaining of crops or of industrial processes with several properties could be used. The 2nd generation biofuels research is not new. It has taken 35 years up to now and still their production is not economical unless there is a technological breakthrough.

Mr. Nils Rettenmaier

2nd generation biofuels when made by wastes are fine but if produced from energy crops they may have competition with food in terms of the land used.

Dr. Luigi Pari

All the plants in Italy are go for 1MW, but it the past the original idea to go for 30MW.

6. How to prioritise the uses of hemp? Is it the production of fibrous materials, the energy production or the impact on rural economy?

Dr. Grzegorz Spychaiski

Using hemp for energy in Poland is prohibited by Law. Consequently, it can be used as insulating and construction material, for mats, for disinfecting materials, and composites for automotive industry.

Prof. Spyros Kyritsis

There are several rules in the EU, but nevertheless each country has to have national rules. In the common rules (based on the carbon dioxide emissions and climate change) EU decided to invest on the biofuels, as the transport sector is responsible for the high increase of CO₂ emissions in the last 20 years. Biomethane use is advantageous compared to biodiesel in terms of energy

	produced and environment, so in Austria there are feed in tariffs in the biogas use.
Dr. Luigi Pari	The goal is to make money. The research community has to produce data ready to be used by the farmers and industry. Our results should be readable to the public so the policy makers and the industry can read them.
Dr. Ralph Sims	Prioritization of uses could be made with difficulty! There are not only the benefits of the bio-product but also the co-benefits: health, social, rural development. Consequently multi-function policies are required, which have to be integrated and collaborate, and that is a difficult task. Policy has to be long, loud and legal! Thorough investigation has to be implemented on how to use wastes in a profitable way. The research community has to enhance the digestibility of the knowledge gained regarding growing crops or producing bio-products and pass the information to the farmers and the market This is not only for biomass but for all renewables. Energy efficiency it is in the agenda for many years.
Dr. Grzegorz Szychowski	Market together with policy will make the decisions.
Prof. Peter Soldatos	To have a long term robust strategy and policy, we have to have long term vision and targets that have to be underpinned by good science. Science has to provide data to the markets. Although it is good to remove subsidies, it is necessary that long term policies are set up, which would rule the industries, in the case that industries cannot lead the way.
Prof Melvyn Askew	Long term vision is needed

At the end of the **round table discussion** Prof. Melvyn Askew thanks the participants for attending this thematic workshop and emphasized the following points:

- ◆ Massive opportunities for several crops and products existed in EU.
- ◆ There are many policies around Europe and the question is how all these policies will be integrated.
- ◆ A methodology is needed to pass the information up.
- ◆ Farmers are not stupid.
- ◆ The farmers and the policy makers need to enhance what the scientists produce.
- ◆ Some products have great environmental benefits.
- ◆ The people are reluctant to change because in most of the cases they do not know.